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Are IM Injections IM in Obese and Overweight Females? A Study in Injection Technique

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Introduction

Intramuscular (IM) injection techniques based on patient weight and body mass index (BMI) may require reevaluation. In order to reach muscle tissue, several studies show that longer needles are necessary to deliver IM injections in overweight and obese individuals based on the amount of subcutaneous tissue over the muscle and needle length (Groswasser, Kahn, Bouche, Hanquinet, Perlmutter, & Hessel, 1997; Zaybak, Günes, Tamsel, Khorshid, & Eser, 2007). An observational study of injection techniques utilized by nurses and medical assistants and their choices of needle size related to the weight and BMI was done in two local clinics in southwestern Idaho. For the purposes of this study, recommendations from the Advisory Committee on Immunization Practices (ACIP) (Kroger, Sumaya, Pickering, & Atkinson, 2012) were used to determine efficacy of deltoid injections, while recommendations from Zaybek, et al., (2007), were used to determine efficacy of dorsogluteal and ventrogluteal injections.

Background

Administering injections is an activity inherent to nursing practice (Beyea & Nicoll, 1995). Though many medications and the majority of vaccines are delivered by IM injection, this injection technique is usually taught once during nursing education and may not be formally revisited thereafter (Malkin, 2008). In addition, many nursing fundamentals textbooks differ on IM injection procedures based on traditional and non-evidence based recommendations (Beyea & Nicoll, 1995; Templeton & McCoy, 2008). It is not clear whether clinician practice is reflective of recommendations for correct and current IM injection technique (Nicoll & Hesby, 2002).

Literature Review

Muscle tissue is more vascular than subcutaneous tissue. Inadvertently giving an injection subcutaneously (SC) intended to be IM may result in improper absorption of drug, altering its effectiveness (Nicoll & Hesby, 2002). It is unclear how much variation from proper technique alters drug effectiveness, but any alteration of effectiveness could result in untoward effects. One drug observed in this study was Depo-Provera, a contraceptive delivered through the IM route. Improper absorption could cause decreased effectiveness. Improper administration can also cause irritation to surrounding tissues, induration, inflammation, or granuloma formation (Kroger et al., 2012). Several factors determine the efficacy of an intramuscular injection.

Needle Length.

Efficacy of IM injections is related to gender, injection site, and subcutaneous tissue thickness (Zaybek et al., 2007). In order to reach muscle tissue, it is important for practitioners to choose the right needle length, determine the amount of subcutaneous tissue present, the weight of the patient, muscle mass, and subcutaneous fat at the injection site before choosing a needle (Kroger, et al., 2012; Malkin, 2008; Zaybek, et al., 2007) (Table 1).

Table 1. Needle length for intramuscular injection in deltoid muscle.

Required Needle Length for Deltoid Injection for Weight and Sex based on ACIP Recommendations (2006).

Weight and Sex	Required Needle Length
Male and Female < 130lb (<60kg)	1-inch needle
Male 130-260lbs (60-118kg) Female 130-200lbs (60-90kg)	1"-1 1/2" needle
Male >260lbs (>118kg) Female >200lbs (>90kg)	1 1/2" needle

In both males and females, the deltoid muscle is preferred when giving most IM injections with 1" needles. A 1-inch needle is required to reach the deltoid muscle tissue in females whose BMI is less than 35. Females with a BMI greater than 35 require a 1-1/4" needle to reach deltoid muscle (Cook, Williamson & Pond, 2006). Zaybek et al., (2007) determined that dorsogluteal and ventrogluteal sites should not be used in women whose BMI is greater than 24.9. These authors further stated obese women have the highest risk of IM injection failure with both ventrogluteal and dorsogluteal sites because of subcutaneous tissue thickness. Interestingly, men of all BMIs may receive dorsogluteal injections without risk of failure because of increased muscle tissue vs. fat tissue (Zaybek et al., 2007).

Bunching-versus-stretching.

Recommended pediatric injection techniques used in practice today include bunching (pinch-grasping) and stretching (flattening) the site prior to and during the injection. In children, bunching the skin while using a 16mm needle will result in a SC injection, whereas if the skin is stretched, a 16mm needle allows IM delivery of the medication (Groswasser et al., 1997, Nicoll & Hesby, 2002). Other factors influencing the injection with a 16 mm needle are obesity (which thickens SC tissue) and whether the needle is inserted fully or if a few millimeters are left outside the skin (Koster, Stellato, Kohn, & Rubin, 2009). Even though these recommendations exist for children and adolescents, there are few recommendations regarding bunching-versus-stretching for adult IM deltoid injections (Chan, Colville, Persaud, Buckley, Hamilton, ... & Modern Lymphnode Imaging, 2006). The ACIP recommends that a 5/8-inch needle is adequate for IM injection into the deltoid muscle only if the skin is not bunched and the weight of the patient is less than 130lbs (60kg) (Kroger et al., 2012).

Research Question

The purpose of this study is to determine if correct intramuscular injection techniques are used based on weight and BMI. In order to make this determination, the questions to be answered are: Is the administrator of the vaccine following current ACIP guidelines and/or Zaybek, et al., (2007), guidelines in regards to weight and BMI when 1. choosing a needle, 2. choosing a site, 3. and deciding whether to bunch or stretch the skin.

The null hypothesis was that weight and BMI are not associated with receiving a correct IM injection.

Methods

Design.

This is a descriptive study utilizing assessment research methods to evaluate injection processes. SPSS (version 19) was used to analyze both descriptive statistics and variables related to IM injection administration. Institutional Review Board approval was obtained through Boise State University.

Informed consent.

Consents were obtained from each patient and medical office personnel stating that they voluntarily agreed to be observed during the injection. The patients also agreed to be weighed and their BMI measured for the study purposes (Attachment 1: Consent for Healthcare Personnel & Attachment 2: Participant Consent).

Data collection.

IM injections were observed being given to 22 adult female patients between the ages of 19 through 41 at a campus health services clinic and a community health clinic in southwest Idaho. No demographic data was collected on race or socioeconomic data. For patients receiving more than one IM injection in an office visit, only the first injection was recorded for this study. The researcher observed the medical office personnel (medical assistants and registered nurses) measure the height and weight of each patient without shoes on equipment available in the office. The researcher collected the height and weight data, and the BMI was calculated by dividing weight in pounds by height in inches squared and multiplying by 703 (CDC Healthy Weight, 2013). Needle length and site of injection were recorded. Angle of injection was recorded as either 90 degree or not 90 degree. Insertion was recorded as fully inserted or not fully inserted. Aspiration was recorded if personnel were observed aspirating back on the plunger. Stretching or bunching of the skin during an injection was also recorded. The variables were compared to ACIP (Kroger, et al., 2012) and Zaybek, et al. (2007) recommendations for each weight category of patient (underweight, normal weight, overweight, and obese) and their BMI (Table 1).

The data collection was conducted in the patient room with the medical personnel and the patient. The observer witnessed the preparation of the injection, physician order, patient verification, instructions to the patient, injection process and documentation. The observer explained the purpose of the study to the patient and the process of witnessing the injection.

Statistical Methods

For each injection, five items required for an injection (Figure 1) were individually recorded as correct (1 point) or incorrect (0 points). There were no items left blank. The five items that determined a correct injection were needle size, site selected, 90-degree angle of insertion, stretching of the skin, and full insertion of the needle. The first two items were scored correct based on weight and BMI requirements, and the last two were scored correct if performed. If any of the 5 items were incorrect, the injection technique was scored as incorrect. Percentages were reported by body weight category for how often the injection was scored as correct. Fisher's exact test was used to test for an association between incorrect IM injection and the body weight category. All analysis used SPSS version 19.

Results

Of all injections observed in patients of all weights, only 50% were given correctly according to ACIP standards by weight (Kroger et al., 2012) and the BMI recommendations set by Zaybek, et al. (2007). Of injections received by overweight and obese people in this study, 17% complied with ACIP guidelines or conversely, for 83% of patients at least one injection criterion was incorrect, rendering the entire injection incorrect according to ACIP. Underweight and normal weight injections were incorrect 10% of the time. In terms of needle length, the needle length for all underweight and normal-weight patients was within guidelines, whereas needle length for overweight and obese patients was incorrect for 75% of injections. A 90-degree insertion angle was documented in 83% of overweight or obese patients, and in 90% of underweight or normal weight patients. The skin was bunched in 33% of overweight and obese injections, and in 10% of normal or underweight weight injections. Full insertion was documented in 50% of overweight and obese injections, and in 80% of normal weight injections.

The null hypothesis that body weight was not associated with incorrect IM injection technique was rejected (Fisher's Exact Test $P < 0.01$). The percentage of patients with incorrect injection technique was 10% in the normal/underweight body weight group and 83% in the overweight/obese body weight group.

Discussion

Evidence-based research requires IM deltoid injections must be given with the correct needle length for body size and given at a 90-degree angle without bunching. If the needle is inserted fully without bunching, with the right needle length according to the patient's BMI and weight, IM injections are likely to reach muscle tissue. The majority of injections witnessed in this study were Depo-Provera. If the effectiveness of the medication is decreased by inaccurate techniques, the results could be costly and preventable.

For decades, the technique for giving an IM injection has been rooted in custom and practice settings. Malkin (2008) questioned these practices as non-evidence based and urged nurses to use weight as a guide to choose the needle length and follow recommended practices for IM injections. This study supports Malkin's recommendations, as the majority of injection techniques observed in 22 patients varied in categories of bunching, stretching, angle of insertion, full needle insertion, aspiration, and needle length.

When nurses are in school, they learn injection techniques from different instructors and different texts used at various nursing schools. In 1995, Beyea and Nicoll reported non-research based and out of date recommendations in various nursing texts. Current up to date nursing textbooks continue to vary in injection procedures. As an example, the textbooks of *Skills in Clinical Nursing* (7th ed.) by Berman and Snyder (2012), and *Nursing Interventions and Clinical Skills* (4th ed.) by Elkin, Perry, and Potter (2007) recommend differing procedures for IM injection (Carter-Templeton & McCoy, 2008). Berman and Snyder (2012) recommend a z-track technique with sliding or pinching the skin, while Elkin, et al., (2007) recommend pulling the skin to the side and not bunching. The variations can be confusing for student nurses, especially because the ACIP does not recommend bunching the skin (Kroger et al., 2012; Groswasser, 1997; Nicoll & Hesby, 2002). Groswasser goes on to further recommend stretching the skin as the most reliable technique for IM delivery (1997). In this study, the bunching technique was used 35% of the time. Therefore, a longer needle is recommended when the provider plans to bunch the skin to ensure the needle will reach muscle tissue.

Considering the results, there is a need for consistent and accurate injection instruction according to the CDC in healthcare education, both in instruction and reference materials. In addition, anywhere injections are given, proper education on injection techniques is needed. The ramifications of this study are twofold: 1. there is a need for more education and training of medical office personnel including medical assistants, licensed practical nurses, and registered nurses, and 2. in this study, patients may have received injections inaccurately resulting in reduced medication effectiveness.

Obesity influences practice, both in adults and children.

According to the Centers of Disease Control and Prevention, there is a difference in choosing needle length and determining thickness of subcutaneous tissue in women versus men. Women with a BMI of 25 or greater have thicker subcutaneous tissue and must receive an injection with a longer needle, according to Zaybek, et al., (2007). In comparison, men with a BMI of over 25 do not need to have a longer needle because they have less subcutaneous tissue than women overall (Zaybek, et al., 2007).

With the increasing rates of obesity, the weight of the patient needs to be considered prior to an IM injection. This study adds to the growing body of evidence that injections are more frequently given outside ACIP guidelines to overweight and obese patients. In this study, 83% of overweight and obese patients did not receive injections correctly, whereas underweight and normal weight patients received injections incorrectly 10% of the time. In a similar study, Chan, et al, (2006) concluded that the majority of assumed IM injections are actually SC. Caution needs to be taken to determine the amount of subcutaneous fat at the injection site, select the correct needle length, insert at a 90 degree angle, and to flatten the skin rather than bunch.

In this study, incorrect needle length was the cause of 7 out of 12 of the failed injections in overweight and obese individuals. Previous research has demonstrated that obese females require a longer needle; this study demonstrates that longer needles are not being considered frequently enough in overweight or obese patients.

Limitations.

Conducting the study at two medical offices and the relatively small sample size were limitations as the results could be different with more medical offices and larger sample. The study took place in an urban setting in southwest Idaho; the results could be different in other states and by other personnel in similar medical offices. The study did not include the years of experience of the healthcare personnel performing the injection. The data collection of more healthcare personnel and their injection techniques could provide different results.

The data collection was conducted in the same room with the patient and medical personnel. One would assume that the medical personnel would follow the most appropriate procedure with a witness present, but mistakes were still made. It is possible that different personnel would have chosen the most correct injection process with a researcher present. Also, the nurse and the patient knew the researcher was watching. This could be a factor in the nurse improving her/his technique; however, the results suggest otherwise.

Finally, the study sample was only witnessed and documented by one data collector while other data collectors could have witnessed and documented differing results. On the other hand, using only one data collector has avoided any inter-rater reliability problems that a larger study would have required.

Idaho does not have CE requirements for RNs or LPNs, nor is there any regulation of medical assistant practices. It would be beneficial to conduct this study in another state with differing requirements of continuing education to maintain licensure, or states that monitor medical assistant training and education.

A need for additional studies involving larger sample sizes and additional locations is warranted to monitor needle size selected, injection site choices, and injection technique. Further injection procedure studies are warranted including an in-depth study of measuring antibody levels to verify effectiveness of IM injections in patients, particularly women.

Conclusion

This study is important in identifying implications for injection practices in various weighted patients. Overweight and obese women are at risk of receiving injections subcutaneously rather than in the muscle as intended. This carries a high risk of reducing medication effectiveness, possibly even causing tissue damage. Appropriate injection technique increases the likelihood of effective delivery of the medication to the muscle, so it is important to choose the proper needle length for IM injection. Determining thickness of subcutaneous fat before administering an IM injection is necessary to ensure that the medication is reaching the muscle.

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